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IRON ORES - DETERMINATION OF CARBON AND SULPHUR IN DRI BY INFRARED METHOD
STATISTICAL EVALUATION OF INTERNATIONAL TEST DATA

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by

R. Sutarno* and W.S. Bowman**

SUMMARY

The analytical data resulting from an international test on the determination of carbon and sulphur in direct reduced iron ores (DRI) by an infrared method using a high frequency furnace conducted by ISO/TC 102/SC 2/WG 24A, have been statistically evaluated. Based on these analytical results, the preliminary precision of these analytical methods can be expressed in terms of the C and S concentration level by the following equation:

C	S
$r = .0429\ X + .0061$	$r = .0696\ X + .0031$
$P = .0537\ X + .0216$	$P = .0373\ X + .0063$
$\sigma_r = .0151\ X + .0022$	$\sigma_r = .0245\ X + .0011$
$\sigma_L = .0167\ X + .0074$	$\sigma_L = .0067\ X + .0021$

where X is the concentration of either C or S in the sample, r is the repeatability, P is the permissible tolerance, σ_r is the within-laboratory standard deviation and σ_L is the between-laboratories standard deviation all in mass %. Six samples containing C and S ranging from 0.05 to 0.3% and 0.003 to 0.06%, respectively, were used in this international test.

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MINERAIS DE FER - DOSAGE DU CARBONE ET DU SOUFRE DANS DES DRI PAR MÉTHODE À L'INFRAROUGE

ÉVALUATION STATISTIQUE DES DONNÉES D'UN ESSAI INTERNATIONAL

par

R. Sutarno* et W.S. Bowman**

RÉSUMÉ

On a évalué statistiquement les résultats analytiques d'un essai international sur le dosage du carbone et du soufre dans des minerais de fer de réduction directe (DRI) par une méthode à l'infrarouge dans laquelle on utilise un four haute fréquence, essai réalisé par le comité ISO/TC 102/TC 102/SC 2/GT 24A. En se basant sur ces résultats analytiques, on peut exprimer la précision préliminaire de ces méthodes analytiques en fonction des concentrations de C et de S à l'aide des équations suivantes:

C	S
$r = 0{,}0429 X + 0{,}0061$	$r = 0{,}0696 X + 0{,}0031$
$P = 0{,}0537 X + 0{,}0216$	$P = 0{,}0373 X + 0{,}0063$
$\sigma_r = 0{,}0151 X + 0{,}0022$	$\sigma_r = 0{,}0245 X + 0{,}0011$
$\sigma_L = 0{,}0167 X + 0{,}0074$	$\sigma_L = 0{,}0067 X + 0{,}0021$

*Chercheur scientifique et **technologue, Section de la chimie physique, Laboratoire de métallurgie extractive, Laboratoires des sciences minérales, CANMET, Energie, Mines et Ressources Canada, Ottawa (Ontario) K1A 0G1

où X est la concentration de C ou de S dans l'échantillon, r est la répétabilité, P est la tolérance admissible, σ_r est l'écart-type intra-laboratoire, et σ_L est l'écart-type inter-laboratoire, tous en % de masse. Dans cet essai international, on a utilisé six échantillons contenant du C et du S dont les concentrations respectives étaient comprises entre 0,05 et 0,3 % et 0,003 et 0,06 %.

INTRODUCTION

At its eleventh meeting, ISO/TC 102/SC 2 (ISO Technical Committee 102 - Iron Ores, Subcommittee 2 - Chemical Analysis) decided to start the development of a standard method for analysis of C and S in direct reduced iron ores (DRI). The method chosen was by the use of a high frequency furnace and infrared finishing. A working group was formed (WG 24A) with participation of nine countries (Australia, Brazil, Canada, France, Germany, Italy, Japan, South Africa and Sweden). The convener was M.H. Gillion of France (Resolution 28).

The working group conducted an international test for the method for the determination of C and S in DRI. The detail of this method is described in document ISO/TC 102/SC 2 N 775E (1). Six samples containing 0.05 to 0.3% C and 0.003 to 0.06% S were used. Eighteen laboratories representing eight countries participated. The data were collected, statistically evaluated and reported to the convener and subsequently to the subcommittee at the twelfth meeting. This report describes the full account of the statistical evaluation of these data.

PRINCIPLE OF ANALYTICAL METHOD

The sample is burnt in a flow of oxygen, in a refractory crucible, in the presence of an accelerator (tungsten). The crucible is inserted in the laboratory tube of a high frequency furnace. The sulphur is converted to SO_2 and the carbon into CO_2. Both gases are measured by an infrared absorption method. The calibration is performed using potassium sulphate and sucrose. This method is designed to be applicable to DRI material containing 0.001 to 0.10% S and 0.005 to 0.30% C. It was still in the first draft stage.

STATISTICAL EVALUATION

The analytical data were statistically evaluated using the procedure described in document ISO/TC 102/SC 2 N 739E (2). This procedure is schematically illustrated in Figure 1. The raw data are also plotted in

Figure 2. The boxed points in these figures signify that these data are suspected outliers and were not used to estimate the grand means and precision. The estimated precisions are plotted against their corresponding means in Figure 3. Linear regression equation of these lines were also computed and are presented in Table 1. Table 2 lists suspected outliers and the ratios between the between laboratories standard deviation, σ_L and the within laboratory standard deviation σ_r.

OBSERVATION

1. Precision and accuracy

The precision obtained from the results of this international test was compared with the precision obtained by WG 3 (3) and WG 4 (4) for the determination of S content by both combustion and gravimetric methods (Table 3). The within-laboratory precision is comparable with that obtained by the gravimetric method. Table 1 shows that σ_L/σ_r ratios are rather high, improvement in the standardization of the method is still necessary. The precision obtained from sample 83-22 seems to be out of line for both C and S. For this reason, the regression equations were computed both including and excluding sample 83-22, and the latter is considered to better represent the preliminary estimate of the precision.

2. Outliers

Table 2 shows that the number of outliers is acceptable with the exception of lab FR 7. This laboratory seems to have difficulty in using the method.

CONCLUSION

In conclusion, based on the results of the first international test, the precision of the analytical methods for the determination of S and C in DRI is reasonable but improvement in the standardization is recommended. Indeed, the subcommittee has decided to continue the development and to conduct another international test for this method (5).

REFERENCES

1. "Iron ores - Determination of carbon and/or sulphur - high frequency/ infrared measurement"; ISO/TC 102/SC 2 (WG 24A) N 775E, April 1985.

2. "Procedure for statistical evaluation of analytical data resulting from international tests"; ISO/TC 102/SC 2 N 739E, April 1982.

3. "Report of working group 3 for the international trial on sulphur determination by gravimetric method"; ISO/TC 102/SC 2 (WG 3) N 412E, January 1976.

4. "Statistical analysis of analytical data resulting from an international trial conducted by ISO/TC 102/SC 2/WG 4 - Method for the determination of sulphur in iron ores by combustion method"; ISO/TC 102/SC 2 (IWG 1-4) N 423E, March 1976.

5. "Draft report of the twelfth meeting of ISO/TC 102/SC 2: Iron ores - chemical analysis"; ISO/TC 102/SC 2 N 781E, November 1984.

Abbreviations Used in this Report

σ_r = SIGMA-R - within laboratory standard deviation

σ_L = SIGMA-L - between laboratories standard deviation

r* = R - repeatability

$= 2.83\ \sigma_r$

p** = permissible tolerance between laboratories

$= 2.83\left(\sigma_L^2 + \sigma_r^2/2\right)^{\frac{1}{2}}$

* Repeatability, r, is the value below which the absolute difference between two independent single test (analysis) results produced by a laboratory on identical material using the same equipment within a short interval of time, using the standardized test method, may be expected to be with a 95% probability.

** Permissible tolerance between laboratories, P, is the value below which the absolute difference between two means of duplicate test results on identical material obtained by operators of different laboratories using the standardized test method, may be expected to lie with a 95% probability.

KO - total number of participating laboratories

K - number of sets of laboratory results used for ANOVA

NO - total number of analytical results

N - No. of analytical results used for ANOVA

COUNTRY ABBREVIATIONS

Au = Australia

FR = France

GER = Germany

IT = Italy

JP = Japan

SA = South Africa

SW = Sweden

Table 1.C

ISO/TC 102/SC 2/WG 24A Carbon and Sulphur in DRI by Infrared Method

SUMMARY OF PRECISIONS FOR ALL SAMPLES

ELEMENT	SAMPLE	KO	K	NO	N	MEAN(X)	REPEATABILITY	PERMISSIBLE TOLERANCE	SIGMA-R	SIGMA-L	SIGMA-L/SIGMA-R
CARBON	83-18	16	13	32	26	.0582	.0031	.0190	.00109	.00686	6.13
CARBON	83-19	16	16	32	32	.0612	.0096	.0304	.00340	.01048	3.08
CARBON	83-20	16	16	32	32	.0804	.0138	.0276	.00489	.00913	1.87
CARBON	83-21	16	15	32	30	.2012	.0166	.0290	.00585	.00936	1.60
CARBON	83-22	16	16	32	32	.2185	.0213	.1069	.00751	.03739	4.98
CARBON	83-23	16	15	32	30	.2915	.0170	.0391	.00801	.01313	2.18

THE REGRESSION EQUATIONS FOR ALL SAMPLES ARE:

					CORR. COEFF.
R	=	.0508 X	+	.0058	.7845
P	=	.1555 X	+	.0184	.4746
SIGMA-R	=	.0180 X	+	.0021	.7847
SIGMA-L	=	.0531 X	+	.0063	.4581

THE REGRESSION EQUATIONS EXCLUDING SAMPLE 83-22 ARE:

					CORR. COEFF.
R	=	.0429 X	+	.0061	.7704
P	=	.0537 X	+	.0218	.7802
SIGMA-R	=	.0151 X	+	.0022	.7706
SIGMA-L	=	.0167 X	+	.0074	.7423

Table 1.S

ISO/TC 102/SC 2/WG 24A Carbon and Sulphur in DRI by Infrared Method

SUMMARY OF PRECISIONS FOR ALL SAMPLES

ELEMENT	SAMPLE	KO	K	NO	N	MEAN(X)	REPEATABILITY	PERMISSIBLE TOLERANCE	SIGMA-R	SIGMA-L	SIGMA-L/SIGMA-R
SULPHUR	83-18	18	18	36	36	.0033	.0017	.0046	.00061	.00155	2.55
SULPHUR	83-19	18	17	36	34	.0302	.0051	.0062	.00179	.00177	.99
SULPHUR	83-20	18	17	36	34	.0165	.0052	.0058	.00182	.00159	.87
SULPHUR	83-21	18	17	36	34	.0491	.0063	.0090	.00222	.00275	1.24
SULPHUR	83-22	18	18	36	36	.0582	.0213	.0884	.00754	.03078	4.08
SULPHUR	83-23	18	18	36	36	.0072	.0048	.0102	.00170	.00338	1.99

THE REGRESSION EQUATION FOR ALL SAMPLES ARE:

					CORR. COEFF.
R	=	.2418 X	+	.0008	.7770
P	=	1.0079 X	+	-.0070	.6826
SIGMA-R	=	.0853 X	+	.0003	.7769
SIGMA-L	=	.3509 X	+	-.0026	.6758

THE REGRESSION EQUATIONS EXCLUDING SAMPLE 83-22 ARE:

					CORR. COEFF.
R	=	.0998 X	+	.0031	.7589
P	=	.0373 X	+	.0083	.2975
SIGMA-R	=	.0245 X	+	.0011	.7600
SIGMA-L	=	.0087 X	+	.0021	.1541

Table 2.C

ISO/TC 102/SC 2/WG 24A Carbon and Sulphur in DRI by Infrared Method

LIST OF OUTLIERS

ELEMENT	SAMPLE	COCHRAN (PRECISION)	DIXON (ACCURACY)	LAB HAS ONLY ONE RESULT	INDIVIDUAL OUTLYING RESULT (DIXON)
CARBON	83-18	BR 1	-	-	-
		FR 7	-	-	-
		SA 1A	-	-	-
CARBON	83-19	-	-	-	-
CARBON	83-20	-	-	-	-
CARBON	83-21	-	FR 7	-	-
CARBON	83-22	-	-	-	-
CARBON	83-23	-	FR 7	-	-

Table 2.S

ISO/TC 102/SC 2/WG 24A Carbon and Sulphur in DRI by Infrared Method

LIST OF OUTLIERS

ELEMENT	SAMPLE	COCHRAN (PRECISION)	DIXON (ACCURACY)	LAB HAS ONLY ONE RESULT	INDIVIDUAL OUTLYING RESULT (DIXON)
SULPHUR	83-18	-	-	-	-
SULPHUR	83-19	-	FR 7	-	-
SULPHUR	83-20	-	FR 7	-	-
SULPHUR	83-21	FR 7	FR 7	-	-
SULPHUR	83-22	-	-	-	-
SULPHUR	83-23	-	-	-	-

Table 3. Precision of the determination of S contents in iron ores by combustion and gravimetric methods estimated from international tests conducted by ISO/TC 102/SC 2/WG 3 and WG 4

WORKING GROUP	EL NAME	METHOD NAME	SAMPLE NAME	GRAND MEAN	REPEATABILITY	PERMISSIBLE TOLERANCE
* WG4	SULPHUR	(COMB)	AUSTRALIA 3762	0.00183	0.00122	0.00181
*			BCS 175/2	0.00650	0.00153	0.00196
*			E-7 KIRUNA	0.01955	0.00176	0.00395
*			JSS 800-1	0.07374	0.00365	0.00609
*			JSS 810-1	0.24938	0.01145	0.02472
* WG3	SULPHUR	(GRAV)	BCS 175/2	0.00570	0.00251	0.00581
*			AKP E7	0.01927	0.00553	0.00693
*			JSS 800/1	0.07713	0.00619	0.00794
*			JSS 810/1	0.25394	0.01840	0.02042
*			AKP E9	0.53309	0.02386	0.03644

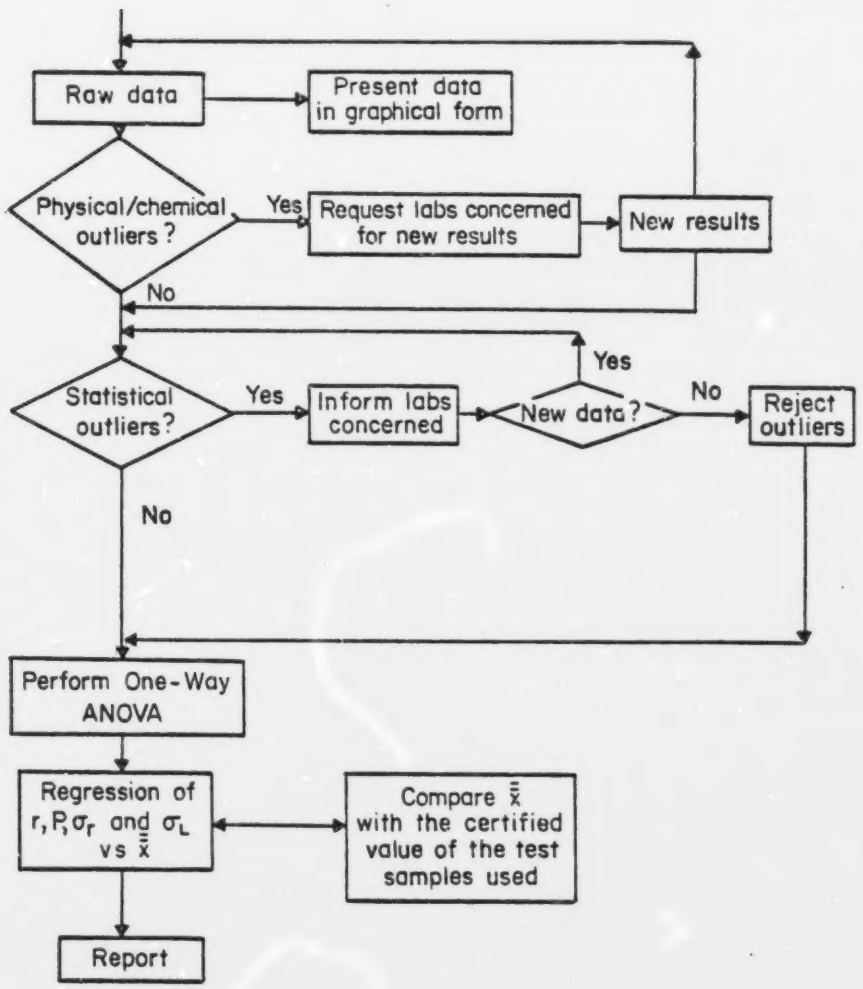

Figure 1. Flow Chart of the Procedure for Statistical Evaluation of Analytical Data Resulting from International Tests

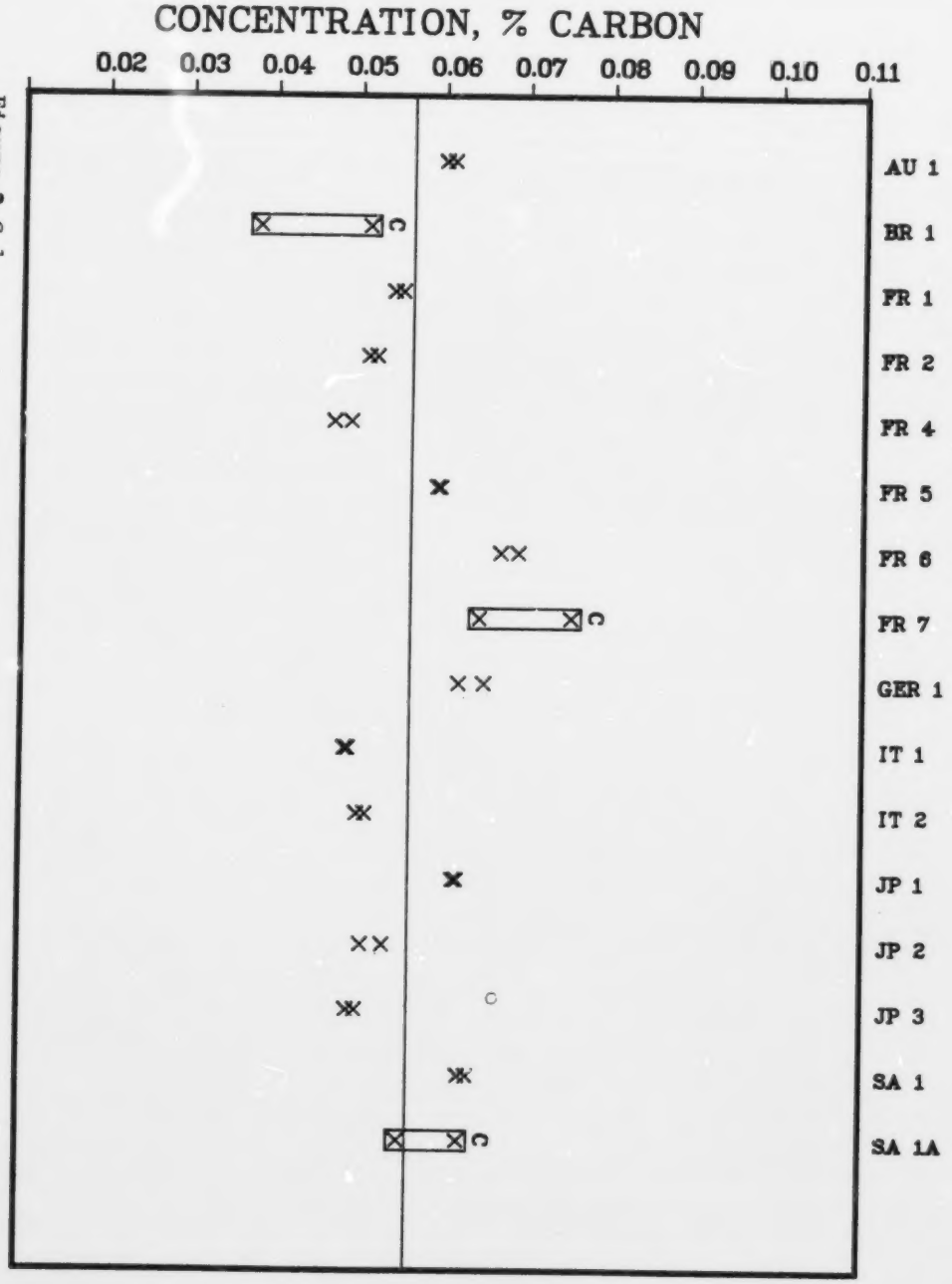

Figure 2.C.1

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

SAMPLE: 83-18 TAZADIT CARBON WT %

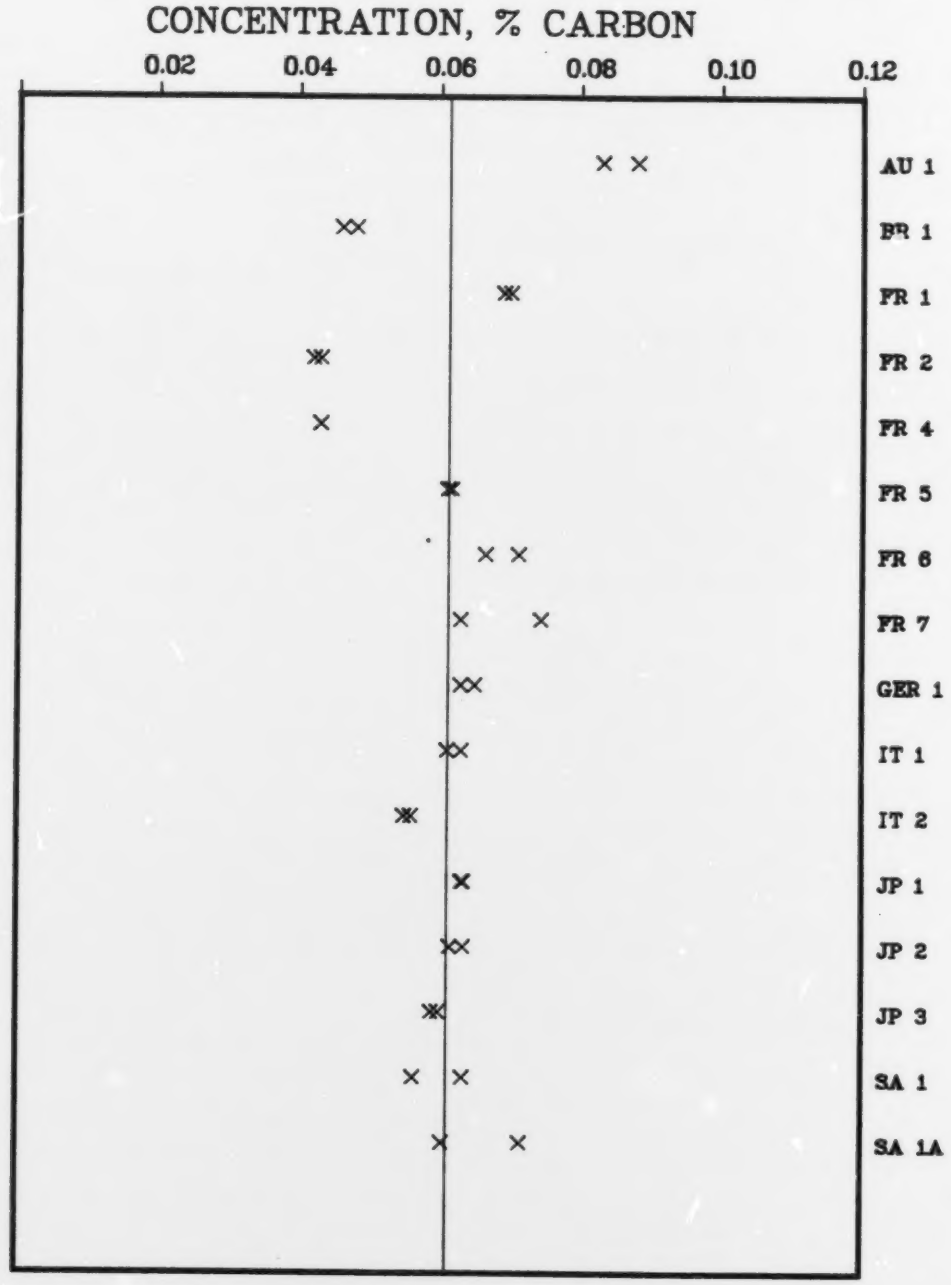

Figure 2.C.2

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

SAMPLE 83-19 BOMI HILL CARBON WT %

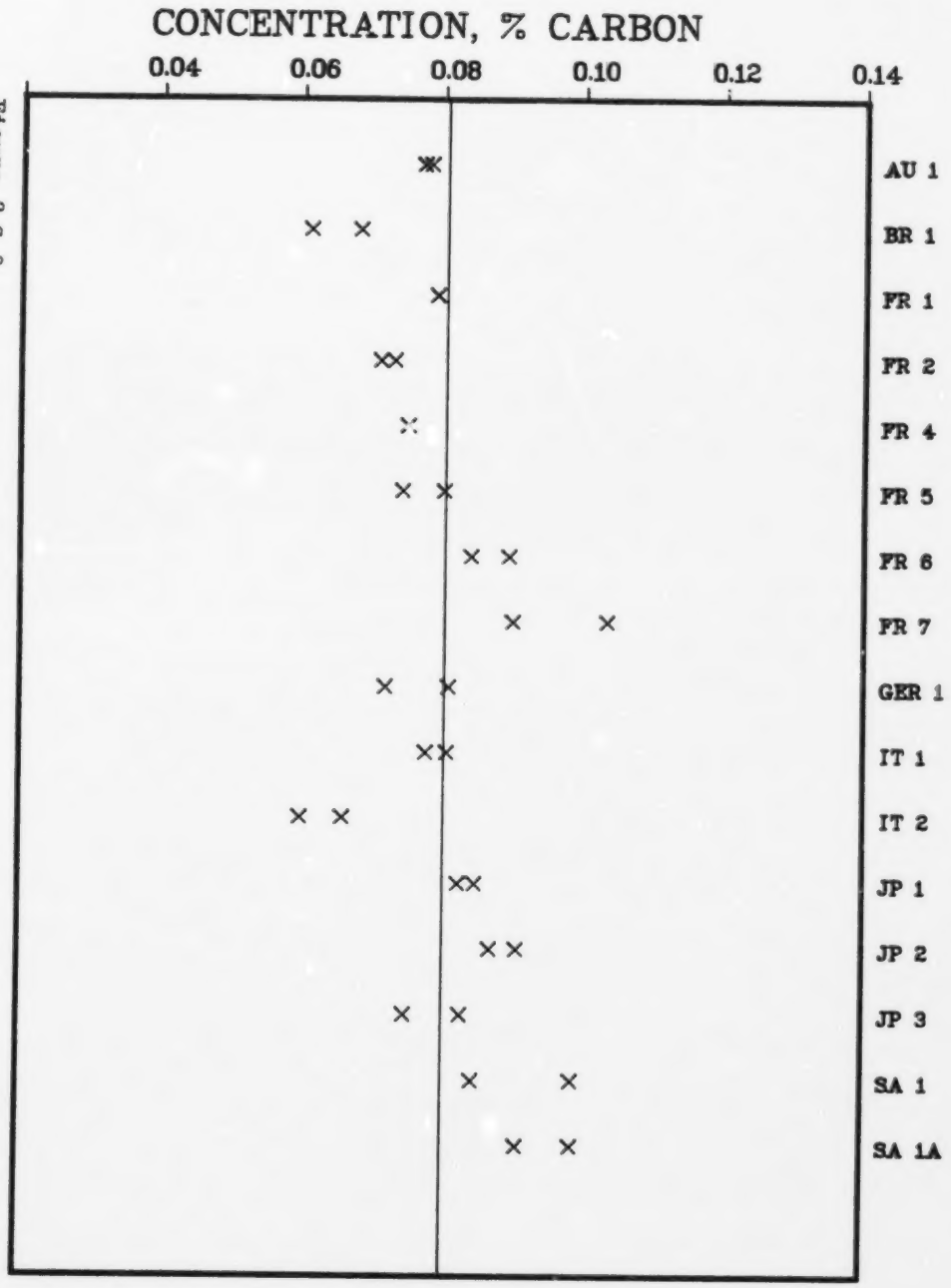

Figure 2.C.3

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

SAMPLE: 83-20 TAZADIT CARBON WT %

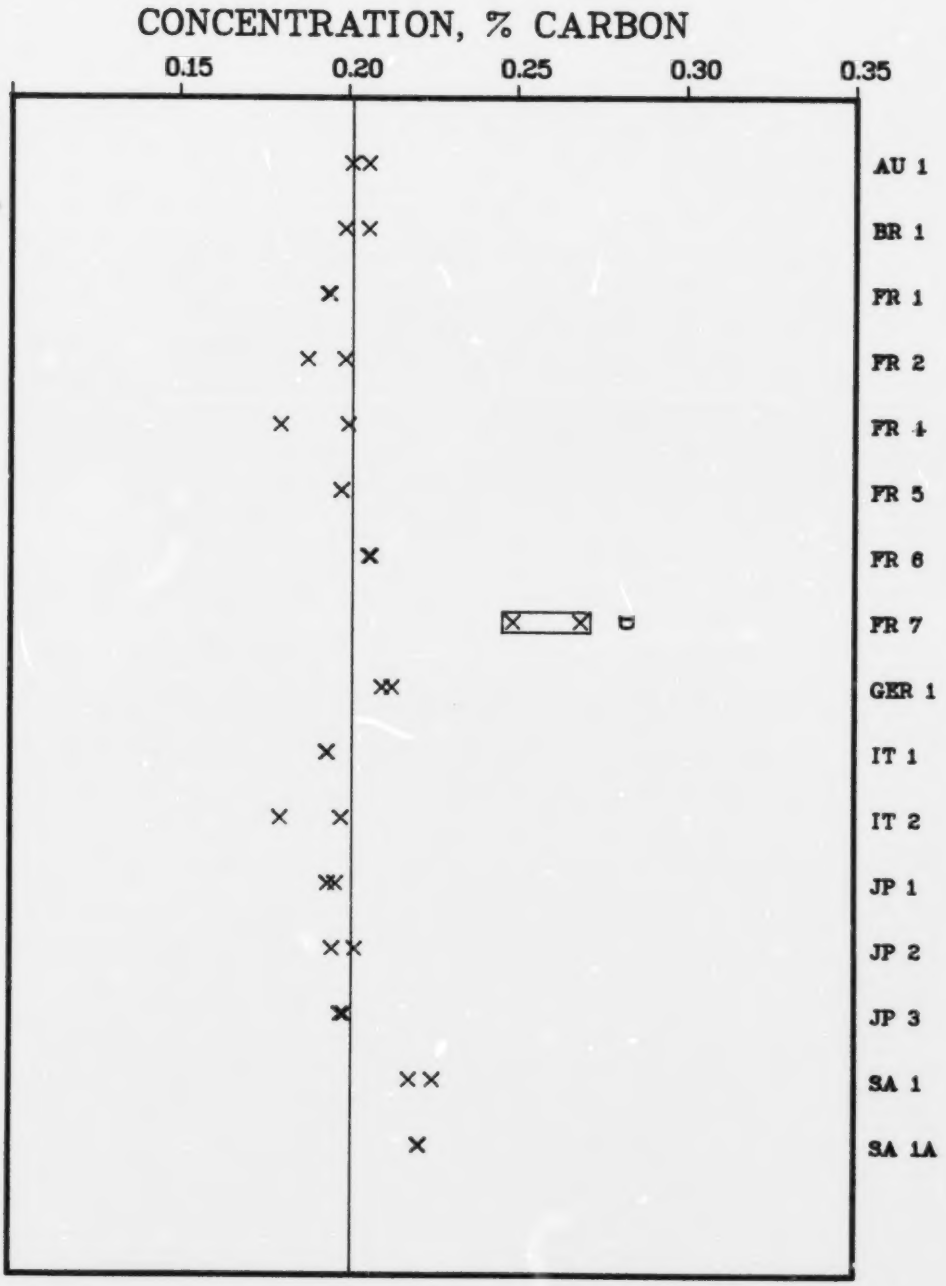

Figure 2.C.4

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

SAMPLE 83-21 KIRUNA KDF CARBON WT %

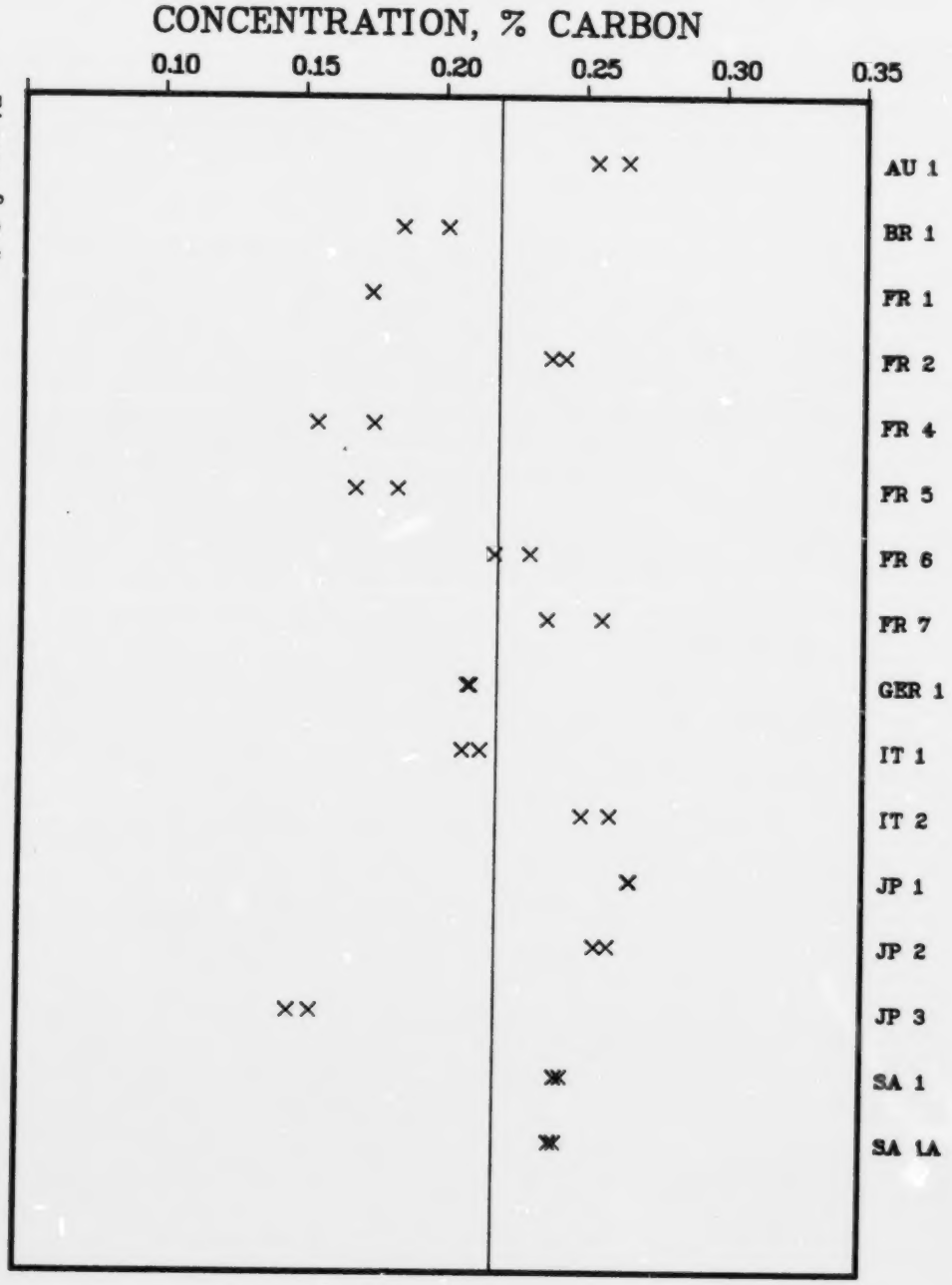

Figure 2.C.5

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

SAMPLE: 83-22 MANO RIVER CARBON WT %

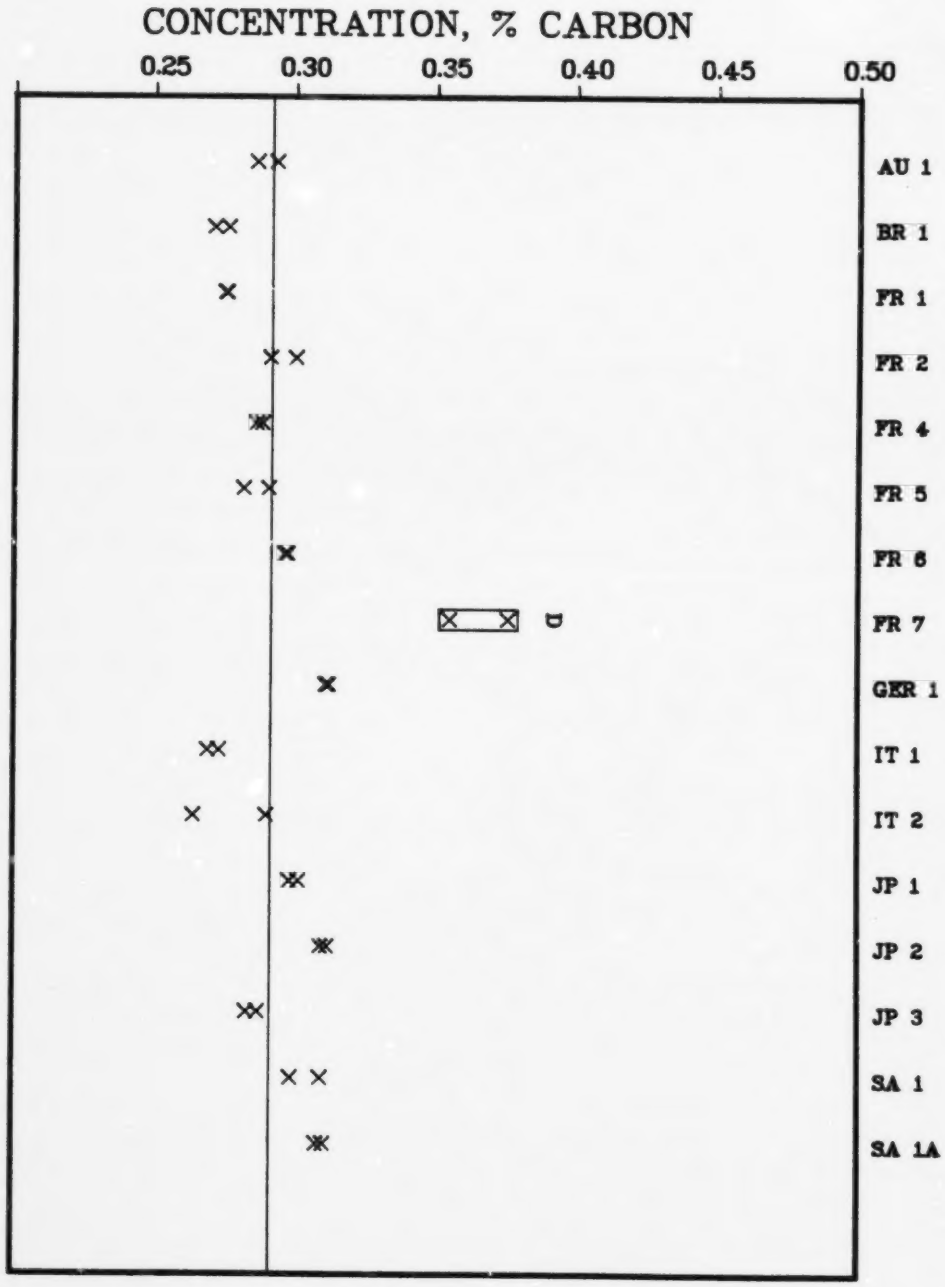

Figure 2.C.6

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

SAMPLE 83-23 GARA DJEBI CARBON WT %

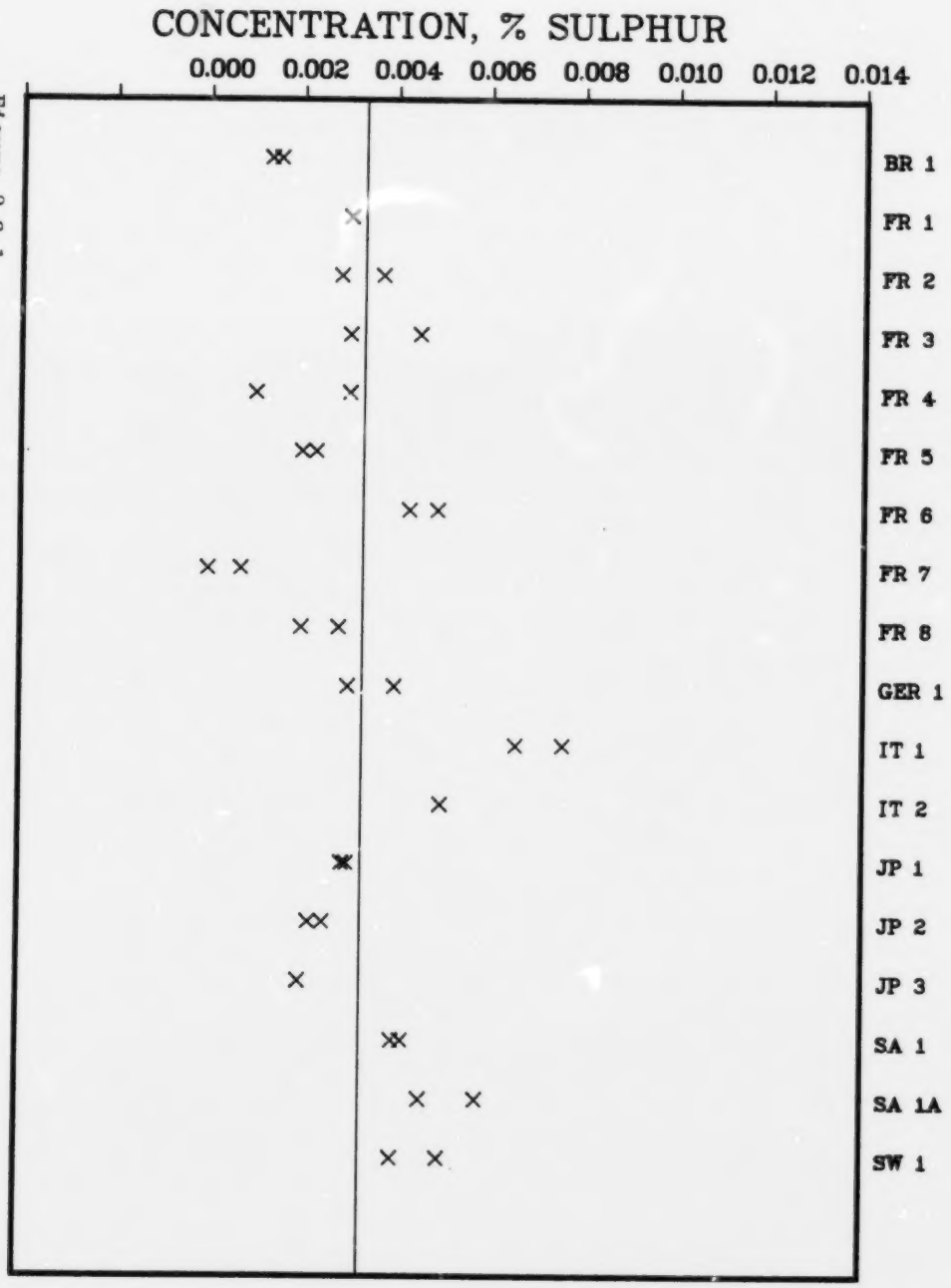

Figure 2.S.1

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

SAMPLE: 83-18 TAZADIT SULPHUR WT %

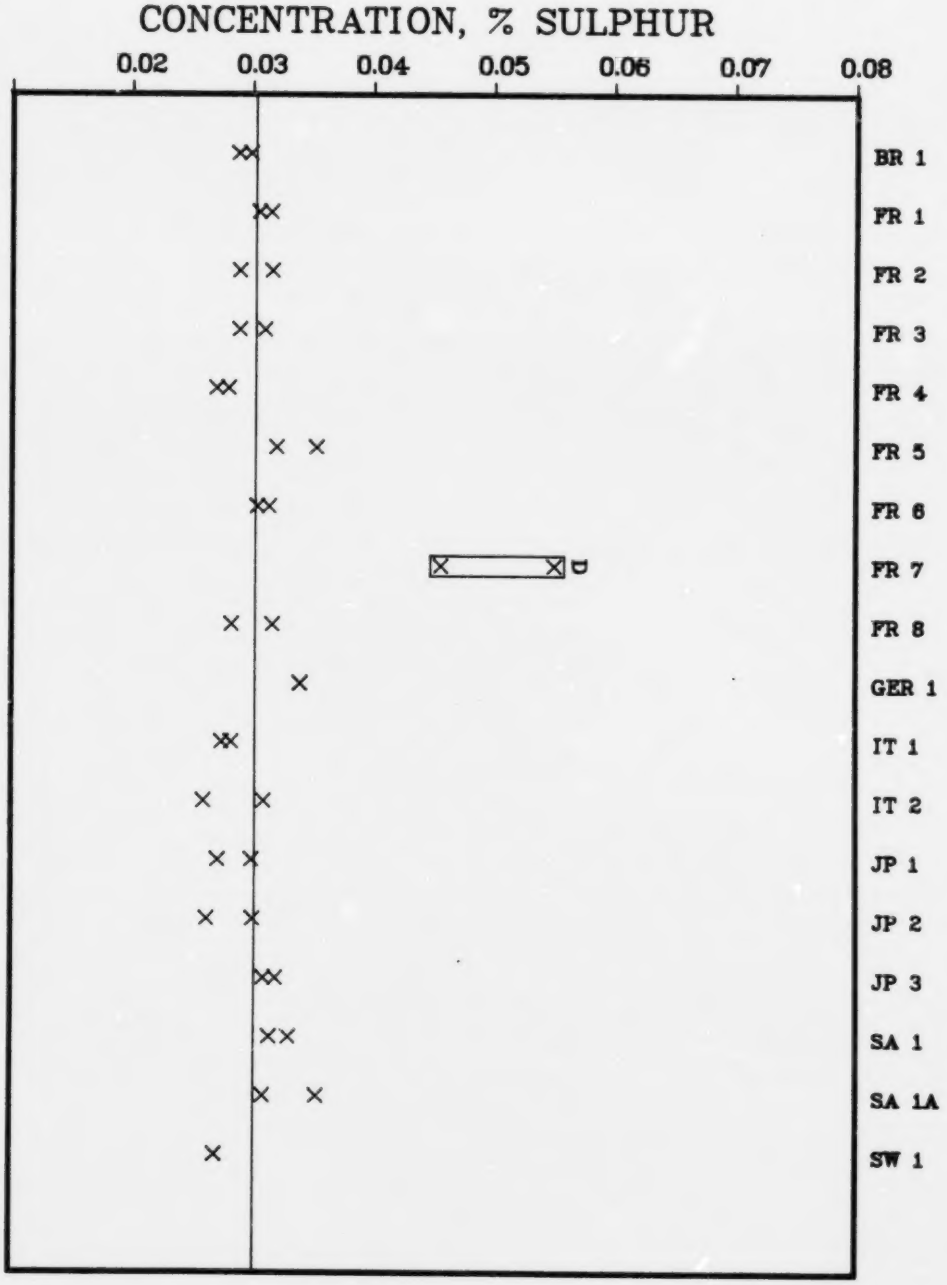

Figure 2.S.2

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHODS

SAMPLE: 83-19 BOMI HILL SULPHUR WT %

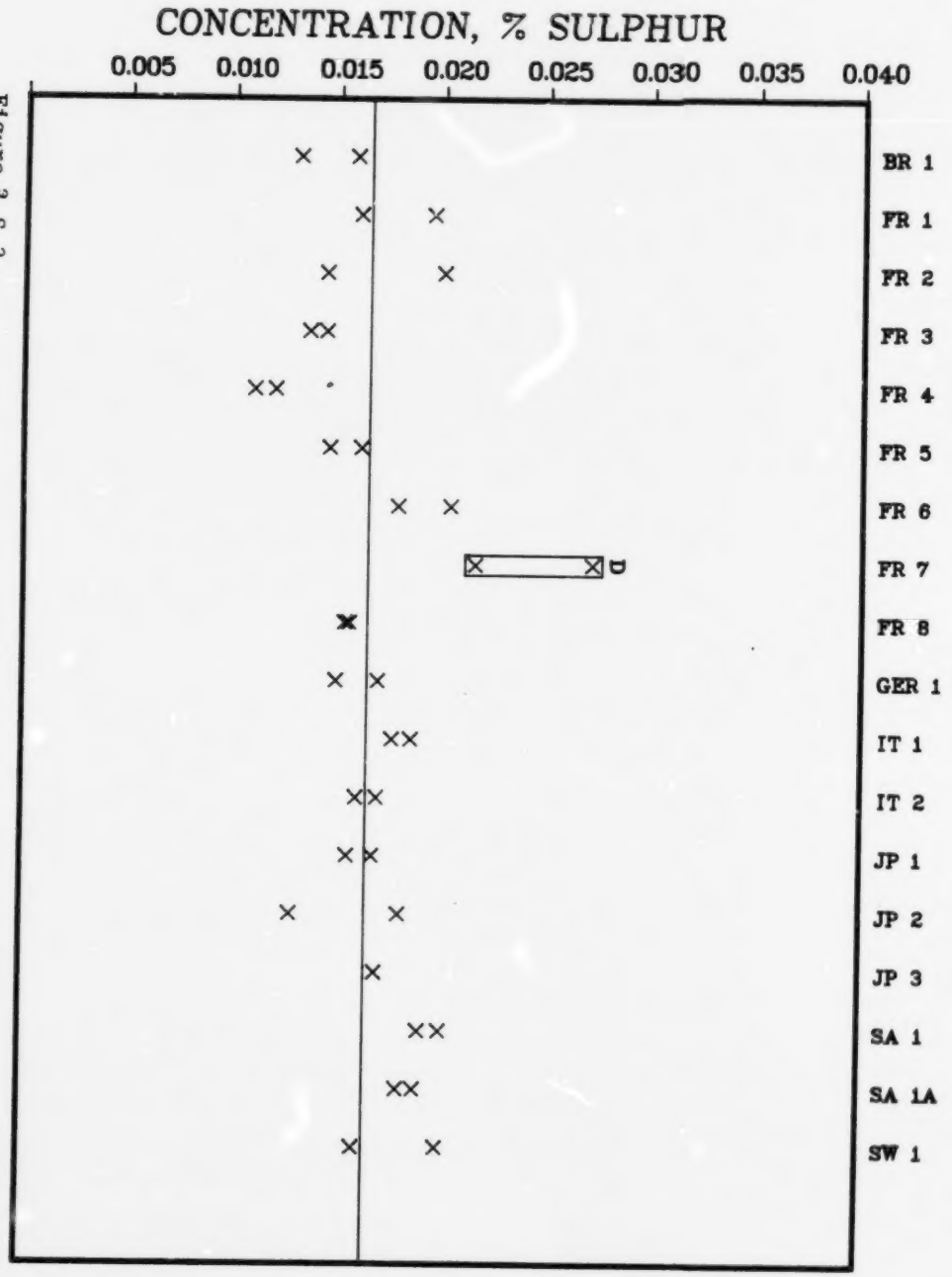

Figure 2.S.3
ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

SAMPLE: 83-20 TAZADIT SULPHUR WT %

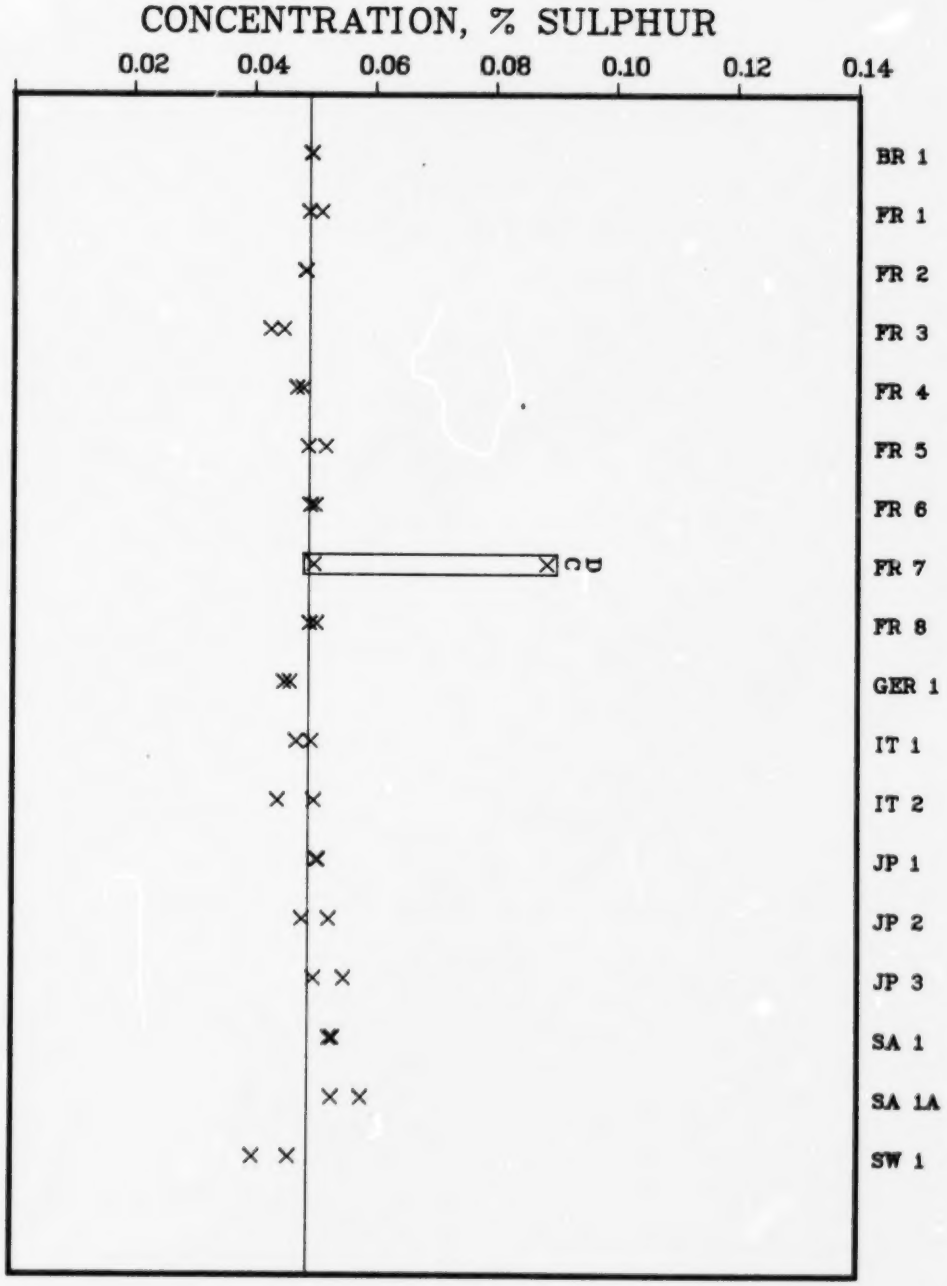

Figure 2.S.4

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

SAMPLE 83-21 KIRUNA KDF SULPHUR WT %

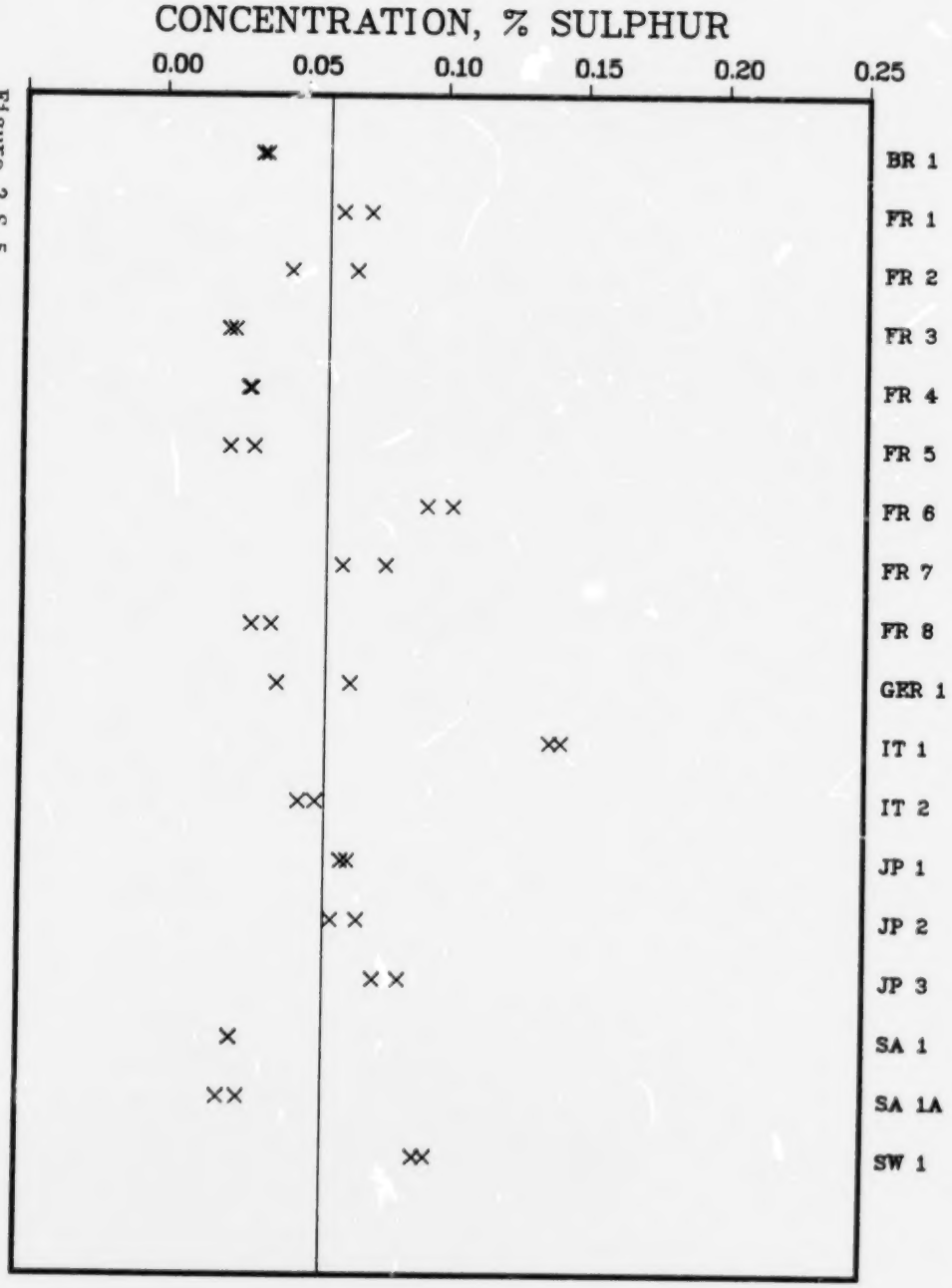

Figure 2.S.5
ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

SAMPLE: 83-22 MANO RIVER SULPHUR WT %

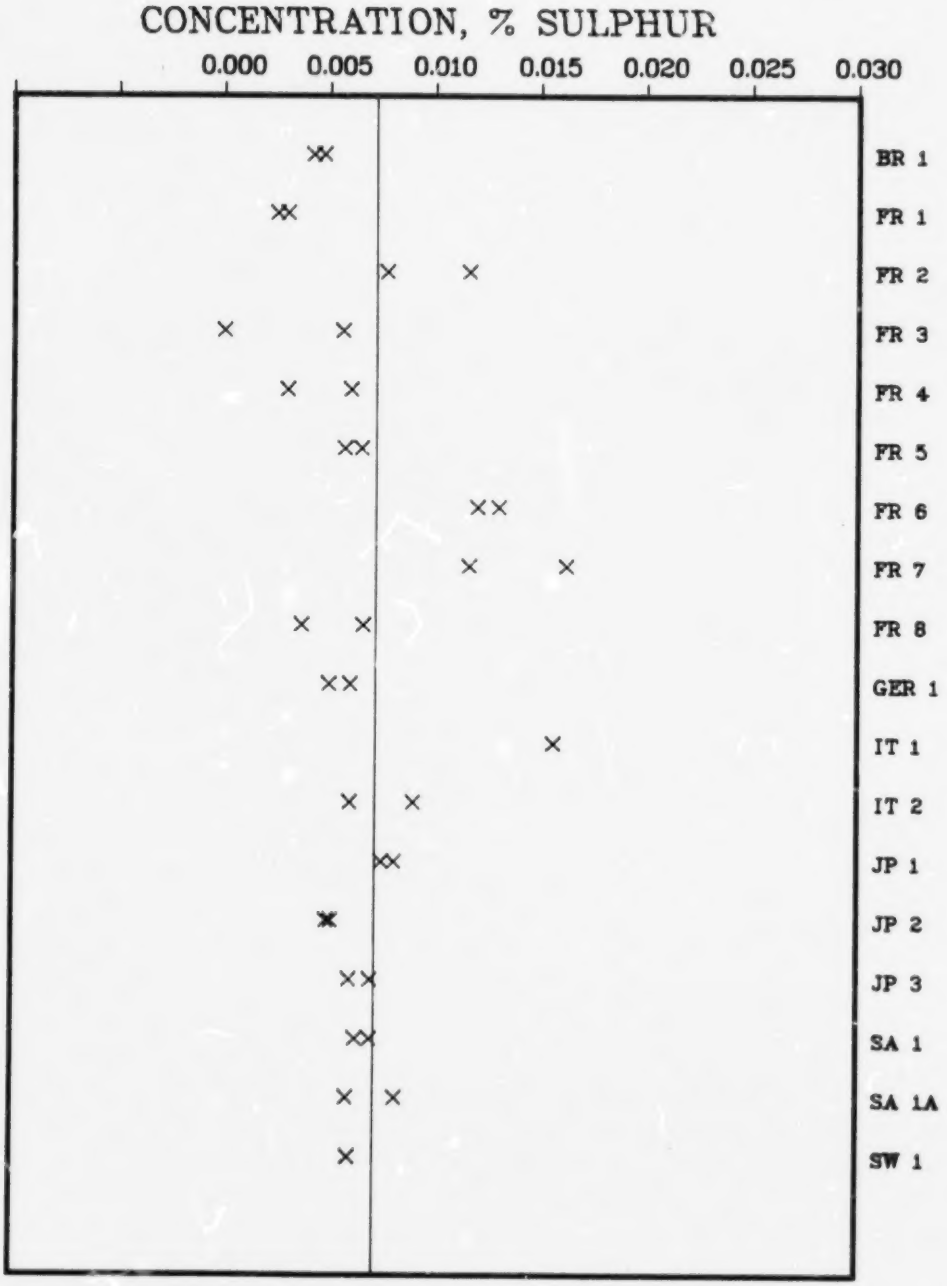

Figure 2.S.6

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

SAMPLE: 83-23 GARA DJEBI SULPHUR WT %

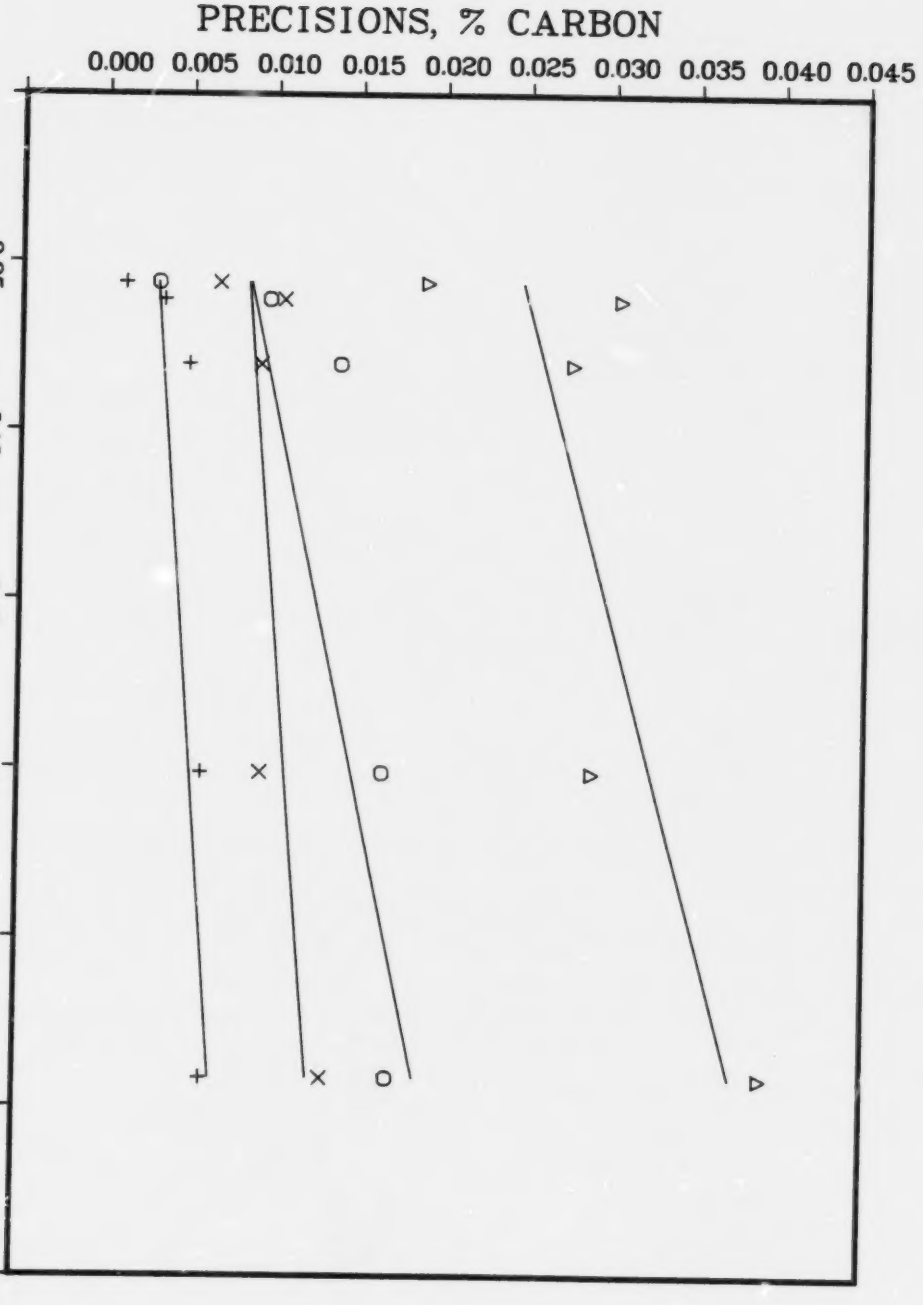

Figure 3.C

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

Figure 3.5

ISO/TC 102/SC 2/WG 24A CARBON AND SULPHUR IN DRI BY INFRARED METHOD

ISO/TC 102/SC 2/WG 24A

APPENDIX A.C

Detailed Computation of the Analytical Data
Carbon

ISO/TC 102/SC 2/WG 24A **CARBON IN DRI BY INFRARED METHOD**
SAMPLE: 63-18

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	AU 1	1	.0610	.0600	.06050	.5000E-06
2	BR 1	1	.0510	.0380	.04450	.8450E-04
3	FR 1	1	.0540	.0550	.05450	.5000E-06
4	FR 2	1	.0510	.0520	.05150	.5000E-06
5	FR 4	1	.0490	.0470	.04800	.2000E-05
6	FR 5	1	.0593	.0597	.05950	.8000E-07
7	FR 6	1	.0669	.0690	.06795	.2205E-05
8	FR 7	1	.0644	.0753	.06985	.5941E-04
9	GER 1	1	.0620	.0650	.06350	.4500E-05
10	IT 1	1	.0485	.0489	.04870	.8000E-07
11	IT 2	1	.0510	.0500	.05050	.5000E-06
12	JP 1	1	.0615	.0619	.06170	.8000E-07
13	JP 2	1	.0532	.0506	.05190	.3380E-05
14	JP 3	1	.0490	.0500	.04950	.5000E-06
15	SA 1	1	.0623	.0633	.06280	.5000E-06
16	SA 1A	1	.0552	.0623	.05875	.2521E-04

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-18

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	25.770
CHI-SQUARE(.95,15)	25.000

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE

LAB- 2	C-CALC =	.458	C-CRIT(2,16) =	.451
LAB- 8	C-CALC =	.594	C-CRIT(2,15) =	.470
LAB-16	C-CALC =	.622	C-CRIT(2,14) =	.491

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 2	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB- 8	COCHRAN'S TEST FOR LABORATORY VARIANCE
LAB-16	COCHRAN'S TEST FOR LABORATORY VARIANCE

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-18

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	12	.10777646E-02	.89813718E-04
WITHIN LABS	13	.15325000E-04	.11788462E-05
TOTAL	25	.10930896E-02	

REPEATABILITY VARIANCE	.11788462E-05
REPEATABILITY STD. DEV.	.00108575
BETWEEN-LABORATORIES VARIANCE	.44317436E-04
BETWEEN-LABORATORIES STD. DEV.	.00665713
REPEATABILITY	.00307266
PERMISSIBLE TOLERANCE BETWEEN LABS	.01896456
GRAND MEAN	.05619615
VARIANCE OF THE GRAND MEAN	.34543738E-05

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-19

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	AU 1	1	.0830	.0880	.08550	.1250E-04
2	BR 1	1	.0460	.0480	.04700	.2000E-05
3	FR 1	1	.0700	.0690	.06950	.3000E-06
4	FR 2	1	.0420	.0430	.04250	.5000E-06
5	FR 4	1	.0430	.0430	.04300	0.
6	FR 5	1	.0617	.0611	.06140	.1800E-06
7	FR 6	1	.0712	.0665	.06885	.1105E-04
8	FR 7	1	.0630	.0744	.06870	.6498E-04
9	GER 1	1	.0650	.0630	.06400	.2000E-05
10	IT 1	1	.0631	.0611	.06210	.2000E-05
11	IT 2	1	.0560	.0550	.05550	.5000E-06
12	JP 1	1	.0632	.0635	.06335	.4500E-07
13	JP 2	1	.0616	.0635	.06255	.1805E-05
14	JP 3	1	.0600	.0590	.05950	.5000E-06
15	SA 1	1	.0565	.0635	.06000	.2450E-04
16	SA 1A	1	.0606	.0717	.06615	.6160E-04

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-19

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	19.294
CHI-SQUARE(.95,14)	23.691

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

ALL RESULTS WERE USED EXCEPT INDIVIDUAL REPLICATES LISTED BELOW

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-19

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	15	.34663400E-02	.23108933E-03
WITHIN LABS	16	.18466000E-03	.11541250E-04
TOTAL	31	.36510000E-02	

REPEATABILITY VARIANCE	.11541250E-04
REPEATABILITY STD. DEV.	.00339724
BETWEEN-LABORATORIES VARIANCE	.10977404E-03
BETWEEN-LABORATORIES STD. DEV.	.01047731
REPEATABILITY	.00961419
PERMISSIBLE TOLERANCE BETWEEN LABS	.03042015
GRAND MEAN	.06122500
VARIANCE OF THE GRAND MEAN	.72215417E-05

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-20

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	AU 1	1	.0780	.0770	.07750	.5000E-06
2	BR 1	1	.0680	.0610	.06450	.2450E-04
3	FR 1	1	.0790	.0790	.07900	0.
4	FR 2	1	.0710	.0730	.07200	.2000E-05
5	FR 4	1	.0750	.0750	.07500	0.
6	FR 5	1	.0743	.0802	.07725	.1741E-04
7	FR 6	1	.0841	.0895	.08680	.1458E-04
8	FR 7	1	.0901	.1035	.09680	.8978E-04
9	GER 1	1	.0720	.0810	.07650	.4050E-04
10	IT 1	1	.0778	.0808	.07930	.4500E-05
11	IT 2	1	.0600	.0660	.06300	.1800E-04
12	JP 1	1	.0849	.0825	.08370	.2880E-05
13	JP 2	1	.0909	.0871	.08900	.7220E-05
14	JP 3	1	.0750	.0830	.07900	.3200E-04
15	SA 1	1	.0847	.0988	.09175	.9941E-04
16	SA 1A	1	.0911	.0988	.09495	.2965E-04

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-20

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	7.741
CHI-SQUARE(.95,13)	22.367

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

ALL RESULTS WERE USED EXCEPT INDIVIDUAL REPLICATES LISTED BELOW

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-20

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	15	.28584997E-02	.19056665E-03
WITHIN LABS	16	.38291500E-03	.23932188E-04
TOTAL	31	.32414147E-02	

REPEATABILITY VARIANCE	.23932188E-04
REPEATABILITY STD. DEV.	.00489205
BETWEEN-LABORATORIES VARIANCE	.83317229E-04
BETWEEN-LABORATORIES STD. DEV.	.00912783
REPEATABILITY	.01384451
PERMISSIBLE TOLERANCE BETWEEN LABS	.02762453
GRAND MEAN	.08037812
VARIANCE OF THE GRAND MEAN	.59552077E-05

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-21

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	AU 1	1	.2010	.2060	.20350	.1250E-04
2	BR 1	1	.2060	.1990	.20250	.2450E-04
3	FR 1	1	.1940	.1945	.19425	.1250E-06
4	FR 2	1	.1990	.1880	.19350	.6050E-04
5	FR 4	1	.2000	.1800	.19000	.2000E-03
6	FR 5	1	.1980	.1979	.19795	.5000E-08
7	FR 6	1	.2060	.2067	.20635	.2450E-06
8	FR 7	1	.2487	.2687	.25870	.2000E-03
9	GER 1	1	.2100	.2130	.21150	.4500E-05
10	IT 1	1	.1937	.1940	.19385	.4500E-07
11	IT 2	1	.1800	.1980	.18900	.1620E-03
12	JP 1	1	.1941	.1964	.19525	.2645E-05
13	JP 2	1	.2021	.1954	.19875	.2245E-04
14	JP 3	1	.1980	.1990	.19850	.5000E-06
15	SA 1	1	.2184	.2253	.22185	.2380E-04
16	SA 1A	1	.2215	.2212	.22135	.4500E-07

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-21

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	31.148
CHI-SQUARE(.95,15)	25.000

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE

NONE REJECTED

DIXON'S TEST FOR LABORATORY MEANS

LAB- 8 R = .573 D-CRIT(16) = .546

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 8 DIXON'S TEST FOR LABORATORY MEANS

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-21

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	14	.29343787E-02	.20959848E-03
WITHIN LABS	15	.51386000E-03	.34257333E-04
TOTAL	29	.34482387E-02	

REPEATABILITY VARIANCE	.34257333E-04
REPEATABILITY STD. DEV.	.00585298
BETWEEN-LABORATORIES VARIANCE	.87670571E-04
BETWEEN-LABORATORIES STD. DEV.	.00936326
REPEATABILITY	.01656392
PERMISSIBLE TOLERANCE BETWEEN LABS	.02897113
GRAND MEAN	.20120667
VARIANCE OF THE GRAND MEAN	.69866159E-05

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-22

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	AU 1	1	.2650	.2540	.25950	.6050E-04
2	BR 1	1	.1850	.2010	.19300	.1280E-03
3	FR 1	1	.1740	.1740	.17400	0.
4	FR 2	1	.2380	.2430	.24050	.1250E-04
5	FR 4	1	.1550	.1750	.16500	.2000E-03
6	FR 5	1	.1686	.1836	.17610	.1125E-03
7	FR 6	1	.2182	.2309	.22455	.8065E-04
8	FR 7	1	.2373	.2568	.24705	.1901E-03
9	GER 1	1	.2090	.2100	.20950	.5000E-06
10	IT 1	1	.2073	.2136	.21045	.1984E-04
11	IT 2	1	.2600	.2500	.25500	.5000E-04
12	JP 1	1	.2675	.2670	.26725	.1250E-06
13	JP 2	1	.2596	.2549	.25725	.1105E-04
14	JP 3	1	.1460	.1540	.15000	.3200E-04
15	SA 1	1	.2434	.2413	.24235	.2205E-05
16	SA 1A	1	.2415	.2396	.24055	.1805E-05

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-22

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	13.964
CHI-SQUARE(.95,14)	23.691

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

ALL RESULTS WERE USED EXCEPT INDIVIDUAL REPLICATES LISTED BELOW

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-22

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	15	.42789135E-01	.28526090E-02
WITHIN LABS	16	.90179500E-03	.56362188E-04
TOTAL	31	.43690930E-01	

REPEATABILITY VARIANCE	.56362188E-04
REPEATABILITY STD. DEV.	.00750748
BETWEEN-LABORATORIES VARIANCE	.13981234E-02
BETWEEN-LABORATORIES STD. DEV.	.03739149
REPEATABILITY	.02124616
PERMISSIBLE TOLERANCE BETWEEN LABS	.10687904
GRAND MEAN	.21950313
VARIANCE OF THE GRAND MEAN	.89144031E-04

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-23

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	AU 1	1	.2930	.2860	.28950	.2450E-04
2	BR 1	1	.2760	.2710	.27350	.1250E-04
3	FR 1	1	.2750	.2755	.27525	.1250E-06
4	FR 2	1	.2910	.3000	.29550	.4050E-04
5	FR 4	1	.2880	.2860	.28700	.2000E-05
6	FR 5	1	.2816	.2905	.28605	.3961E-04
7	FR 6	1	.2963	.2974	.29685	.6050E-06
8	FR 7	1	.3548	.3755	.36515	.2142E-03
9	GER 1	1	.3110	.3120	.31150	.5000E-06
10	IT 1	1	.2730	.2690	.27100	.8000E-05
11	IT 2	1	.2640	.2900	.27700	.3380E-03
12	JP 1	1	.2982	.3014	.29980	.5120E-05
13	JP 2	1	.3116	.3093	.31045	.2645E-05
14	JP 3	1	.2830	.2870	.28500	.8000E-05
15	SA 1	1	.3095	.2989	.30420	.5618E-04
16	SA 1A	1	.3081	.3106	.30935	.3125E-05

ISO/TC 102/SC 2/WG 04A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-23

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	20.702
CHI-SQUARE(.95,15)	25.000

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DIXON'S TEST FOR LABORATORY MEANS

LAB- 8 R = .608 D-CRIT(16) = .546

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 8 DIXON'S TEST FOR LABORATORY MEANS

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A CARBON IN DRI BY INFRARED METHOD
SAMPLE: 83-23

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	14	.53345447E-02	.38103890E-03
WITHIN LABS	15	.54140500E-03	.36093667E-04
TOTAL	29	.58759497E-02	

REPEATABILITY VARIANCE	.36093667E-04
REPEATABILITY STD. DEV.	.00600780
BETWEEN-LABORATORIES VARIANCE	.17247262E-03
BETWEEN-LABORATORIES STD. DEV.	.01313288
REPEATABILITY	.01700208
PERMISSIBLE TOLERANCE BETWEEN LABS	.03906215
GRAND MEAN	.29146333
VARIANCE OF THE GRAND MEAN	.12701297E-04

ISO/TC 102/SC 2/WG 24A

APPENDIX A.S.

Analytical Computation of the Analytical Data
Sulphur

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-18

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	BR 1	1	.0013	.0015	.00140	.2000E-07
2	FR 1	1	.0030	.0030	.00300	0.
3	FR 2	1	.0037	.0028	.00325	.4050E-06
4	FR 3	1	.0045	.0030	.00375	.1125E-05
5	FR 4	1	.0030	.0010	.00200	.2000E-05
6	FR 5	1	.0023	.0020	.00215	.4500E-07
7	FR 6	1	.0043	.0049	.00460	.1800E-06
8	FR 7	1	0.0000	.0007	.00035	.2450E-06
9	FR 8	1	.0020	.0028	.00240	.3200E-06
10	GER 1	1	.0030	.0040	.00350	.5000E-06
11	IT 1	1	.0076	.0066	.00710	.5000E-06
12	IT 2	1	.0050	.0050	.00500	0.
13	JP 1	1	.0029	.0030	.00295	.5000E-08
14	JP 2	1	.0022	.0025	.00235	.4500E-07
15	JP 3	1	.0020	.0020	.00200	0.
16	SA 1	1	.0040	.0042	.00410	.2000E-07
17	SA 1A	1	.0046	.0058	.00520	.7200E-06
18	SW 1	1	.0040	.0050	.00450	.5000E-06

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-18

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	10.209
CHI-SQUARE(.95,14)	23.691

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

ALL RESULTS WERE USED EXCEPT INDIVIDUAL REPLICATES LISTED BELOW

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-18

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	17	.87785556E-04	.51638562E-05
WITHIN LABS	18	.66300000E-05	.36833333E-06
TOTAL	35	.94415556E-04	

REPEATABILITY VARIANCE	.36833333E-06
REPEATABILITY STD. DEV.	.00060690
BETWEEN-LABORATORIES VARIANCE	.23977614E-05
BETWEEN-LABORATORIES STD. DEV.	.00154847
REPEATABILITY	.00171754
PERMISSIBLE TOLERANCE BETWEEN LABS	.00454735
GRAND MEAN	.00331111
VARIANCE OF THE GRAND MEAN	.14344045E-06

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-19

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	BR 1	1	.0288	.0298	.02930	.5000E-06
2	FR 1	1	.0315	.0305	.03100	.5000E-06
3	FR 2	1	.0289	.0316	.03025	.3645E-05
4	FR 3	1	.0310	.0289	.02995	.2205E-05
5	FR 4	1	.0280	.0270	.02750	.5000E-06
6	FR 5	1	.0320	.0353	.03365	.5445E-05
7	FR 6	1	.0304	.0314	.03090	.5000E-06
8	FR 7	1	.0550	.0456	.05030	.4418E-04
9	FR 8	1	.0283	.0317	.03000	.5780E-05
10	GER 1	1	.0340	.0340	.03400	0.
11	IT 1	1	.0275	.0283	.02790	.3200E-06
12	IT 2	1	.0310	.0260	.02850	.1250E-04
13	JP 1	1	.0272	.0300	.02860	.3920E-05
14	JP 2	1	.0301	.0263	.02820	.7220E-05
15	JP 3	1	.0320	.0310	.03150	.5000E-06
16	SA 1	1	.0331	.0315	.03230	.1280E-05
17	SA 1A	1	.0310	.0354	.03320	.9680E-05
18	SW 1	1	.0270	.0270	.02700	0.

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-19

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	11.820
CHI-SQUARE(.95,15)	25.000

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DIXON'S TEST FOR LABORATORY MEANS

LAB- 8 R = .743 D-CRIT(18) = .515

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 8 DIXON'S TEST FOR LABORATORY MEANS

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-19

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	16	.15150059E-03	.94687868E-05
WITHIN LABS	17	.54495000E-04	.32055882E-05
TOTAL	33	.20599559E-03	

REPEATABILITY VARIANCE	.32055882E-05
REPEATABILITY STD. DEV.	.00179042
BETWEEN-LABORATORIES VARIANCE	.31315993E-05
BETWEEN-LABORATORIES STD. DEV.	.00176963
REPEATABILITY	.00506688
PERMISSIBLE TOLERANCE BETWEEN LABS	.00615770
GRAND MEAN	.03022059
VARIANCE OF THE GRAND MEAN	.27849373E-06

ISO/TC 102/SC 2/WG 04A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-20

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	BR 1	1	.0158	.0131	.01445	.3645E-05
2	FP 1	1	.0193	.0160	.01775	.6125E-05
3	FR 2	1	.0200	.0144	.01720	.1568E-04
4	FR 3	1	.0144	.0136	.01400	.3200E-06
5	FR 4	1	.0110	.0120	.01150	.5000E-06
6	FR 5	1	.0161	.0146	.01535	.1125E-05
7	FR 6	1	.0204	.0179	.01915	.3125E-05
8	FR 7	1	.0272	.0216	.02440	.1568E-04
9	FR 8	1	.0154	.0156	.01550	.2000E-07
10	GER 1	1	.0170	.0150	.01600	.2000E-05
11	IT 1	1	.0177	.0186	.01815	.4050E-06
12	IT 2	1	.0160	.0170	.01650	.5000E-06
13	JP 1	1	.0156	.0168	.01620	.7200E-06
14	JP 2	1	.0129	.0181	.01550	.1352E-04
15	JP 3	1	.0170	.0170	.01700	0.
16	SA 1	1	.0191	.0201	.01960	.5000E-06
17	SA 1A	1	.0189	.0181	.01850	.3200E-06
18	SW 1	1	.0200	.0160	.01800	.8000E-05

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-20

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	13.926
CHI-SQUARE(.95,16)	26.301

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DIXON'S TEST FOR LABORATORY MEANS

LAB- 8 R = .528 D-CRIT(18) = .515

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 8 DIXON'S TEST FOR LABORATORY MEANS

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-20

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	16	.13404235E-03	.83776471E-05
WITHIN LABS	17	.56505000E-04	.33238235E-05
TOTAL	33	.19054735E-03	

REPEATABILITY VARIANCE	.33238235E-05
REPEATABILITY STD. DEV.	.00182314
BETWEEN-LABORATORIES VARIANCE	.25269118E-05
BETWEEN-LABORATORIES STD. DEV.	.00158963
REPEATABILITY	.00515947
PERMISSIBLE TOLERANCE BETWEEN LABS	.00579205
GRAND MEAN	.01649118
VARIANCE OF THE GRAND MEAN	.24640138E-06

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-21

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	BR 1	1	.0493	.0494	.04935	.5000E-08
2	FR 1	1	.0510	.0490	.05000	.2000E-05
3	FR 2	1	.0483	.0485	.04840	.2000E-07
4	FR 3	1	.0426	.0448	.04370	.2420E-05
5	FR 4	1	.0470	.0480	.04750	.5000E-06
6	FR 5	1	.0518	.0489	.05035	.4205E-05
7	FR 6	1	.0493	.0501	.04970	.3200E-06
8	FR 7	1	.0885	.0499	.06920	.7450E-03
9	FR 8	1	.0503	.0492	.04975	.6050E-06
10	GER 1	1	.0460	.0450	.04550	.5000E-06
11	IT 1	1	.0471	.0495	.04830	.2880E-05
12	IT 2	1	.0500	.0440	.04700	.1800E-04
13	JP 1	1	.0507	.0504	.05055	.4500E-07
14	JP 2	1	.0525	.0481	.05030	.9680E-05
15	JP 3	1	.0550	.0500	.05250	.1250E-04
16	SA 1	1	.0532	.0526	.05290	.1800E-06
17	SA 1A	1	.0530	.0579	.05545	.1200E-04
18	SW 1	1	.0400	.0460	.04300	.1800E-04

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-21

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	46.042
CHI-SQUARE(.95,17)	27.593

VARIANCE IS INHOMOGENEOUS

COCHRAN'S TEST FOR LABORATORY VARIANCE

LAB- 8 C-CALC = .899 C-CRIT(2,18) = .418

DIXON'S TEST FOR LABORATORY MEANS

LAB- 8 R = .688 D-CRIT(18) = .515

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

LAB- 8 DIXON'S TEST FOR LABORATORY MEANS

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-21

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	16	.32100118E-03	.20062574E-04
WITHIN LABS	17	.83865000E-04	.49332353E-05
TOTAL	33	.40486618E-03	

REPEATABILITY VARIANCE	.49332353E-05
REPEATABILITY STD. DEV.	.00222109
BETWEEN-LABORATORIES VARIANCE	.75646691E-05
BETWEEN-LABORATORIES STD. DEV.	.00275039
REPEATABILITY	.00628568
PERMISSIBLE TOLERANCE BETWEEN LABS	.00896323
GRAND MEAN	.04907353
VARIANCE OF THE GRAND MEAN	.59007569E-06

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-22

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	BR 1	1	.0358	.0342	.03500	.1280E-05
2	FR 1	1	.0630	.0730	.06800	.5000E-04
3	FR 2	1	.0680	.0450	.05650	.2645E-03
4	FR 3	1	.0250	.0229	.02395	.2205E-05
5	FR 4	1	.0310	.0300	.03050	.5000E-06
6	FR 5	1	.0321	.0235	.02780	.3698E-04
7	FR 6	1	.1030	.0939	.09845	.4141E-04
8	FR 7	1	.0639	.0793	.07160	.1186E-03
9	FR 8	1	.0316	.0387	.03515	.2521E-04
10	GER 1	1	.0410	.0670	.05400	.3380E-03
11	IT 1	1	.1380	.1420	.14000	.8000E-05
12	IT 2	1	.0490	.0550	.05200	.1800E-04
13	JP 1	1	.0642	.0666	.06540	.2880E-05
14	JP 2	1	.0609	.0701	.06550	.4232E-04
15	JP 3	1	.0850	.0760	.08050	.4050E-04
16	SA 1	1	.0256	.0253	.02545	.4500E-07
17	SA 1A	1	.0212	.0283	.02475	.2521E-04
18	SW 1	1	.0910	.0950	.09300	.8000E-05

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-22

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	19.277
CHI-SQUARE(.95,17)	27.593

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

ALL RESULTS WERE USED EXCEPT INDIVIDUAL REPLICATES LISTED BELOW

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-22

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	17	.33169705E-01	.19511591E-02
WITHIN LABS	18	.10236050E-02	.56866944E-04
TOTAL	35	.34193310E-01	

REPEATABILITY VARIANCE	.56866944E-04
REPEATABILITY STD. DEV.	.00754102
BETWEEN-LABORATORIES VARIANCE	.94714608E-03
BETWEEN-LABORATORIES STD. DEV.	.03077574
REPEATABILITY	.02134108
PERMISSIBLE TOLERANCE BETWEEN LABS	.08839298
GRAND MEAN	.05819722
VARIANCE OF THE GRAND MEAN	.54198864E-04

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-23

LABORATORY NO.	COUNTRY	BOTTLE NO.	ANALYTICAL RESULTS		LAB MEAN	LAB VARIANCE
1	BR 1	1	.0047	.0042	.00445	.1250E-06
2	FR 1	1	.0025	.0030	.00275	.1250E-06
3	FR 2	1	.0077	.0116	.00965	.7605E-05
4	FR 3	1	.0056	0.0000	.00280	.1568E-04
5	FR 4	1	.0060	.0030	.00450	.4500E-05
6	FR 5	1	.0065	.0057	.00610	.3200E-06
7	FR 6	1	.0120	.0130	.01250	.5000E-06
8	FR 7	1	.0116	.0162	.01390	.1058E-04
9	FR 8	1	.0037	.0066	.00515	.4205E-05
10	GER 1	1	.0050	.0060	.00550	.5000E-06
11	IT 1	1	.0156	.0156	.01560	0.
12	IT 2	1	.0090	.0060	.00750	.4500E-05
13	JP 1	1	.0075	.0081	.00780	.1800E-06
14	JP 2	1	.0051	.0049	.00500	.2000E-07
15	JP 3	1	.0070	.0060	.00650	.5000E-06
16	SA 1	1	.0063	.0070	.00665	.2450E-06
17	SA 1A	1	.0059	.0082	.00705	.2645E-05
18	SW 1	1	.0060	.0060	.00600	0.

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-23

BARTLETT'S TEST FOR HOMOGENEITY OF LABORATORY VARIANCE

CALCULATED STATISTIC	15.347
CHI-SQUARE(.95,15)	25.000

VARIANCE IS HOMOGENEOUS
(COCHRAN'S TEST NOT PERFORMED)

DIXON'S TEST FOR LABORATORY MEANS

NONE REJECTED

LIST OF LABORATORIES WHOSE RESULTS WERE NOT USED FOR ONE-WAY ANOVA

ALL RESULTS WERE USED EXCEPT INDIVIDUAL REPLICATES LISTED BELOW

LIST OF INDIVIDUAL OUTLIERS DETECTED BY DIXON'S TEST WITHIN-LABORATORIES

NONE REJECTED

ISO/TC 102/SC 2/WG 24A SULPHUR IN DRI BY INFRARED METHOD
SAMPLE: 83-23

ONE-WAY ANALYSIS OF VARIANCE TABLE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE
BETWEEN LABS	17	.43880556E-03	.25812092E-04
WITHIN LABS	18	.52230000E-04	.29016667E-05
TOTAL	35	.49103556E-03	

REPEATABILITY VARIANCE	.29016667E-05
REPEATABILITY STD. DEV.	.00170343
BETWEEN-LABORATORIES VARIANCE	.11455212E-04
BETWEEN-LABORATORIES STD. DEV.	.00338455
REPEATABILITY	.00482070
PERMISSIBLE TOLERANCE BETWEEN LABS	.01016677
GRAND MEAN	.00718889
VARIANCE OF THE GRAND MEAN	.71700254E-06